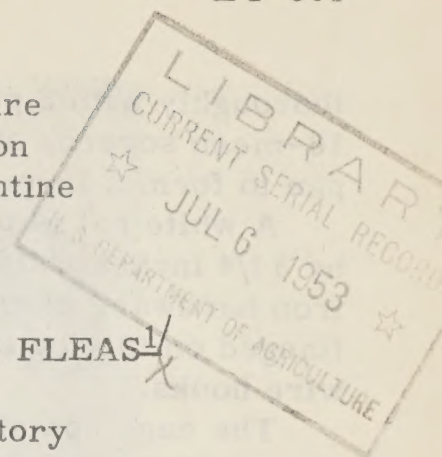


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United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine



X TECHNIQUES FOR REARING AND HANDLING FLEAS^{1/}X

Prepared at the Orlando, Fla., Laboratory
Division of Insects Affecting Man and Animals

The oriental rat flea (Xenopsylla cheopis (Rothsch.)) and the cat flea (Ctenocephalides felis (Bouché)) are reared in large numbers at the Orlando, Fla., laboratory for use in studies of insecticides and repellents. Certain aspects of the methods employed in rearing these species have been described previously, but all the methods have been modified to produce large numbers of fleas of uniform age with a minimum of handling.

The Oriental Rat Flea

White rats are used as hosts for the adult fleas, and the rearing medium is a mixture of dry sand and powdered beef blood. The infested rat is confined in a small screen cage which is kept in a large pan containing a thin layer of the blood and sand mixture. These rearing pans are held in a constant-temperature room at about 80° F. After 21 days the rearing medium is transferred to a white porcelain pan for completion of larval development and pupation. At weekly intervals the cocoons are removed and placed in emergence units that provide facilities for the convenient collection and handling of the young adult fleas as they emerge from the cocoons.

Each rearing pan is maintained with two rats, each rat being kept 3 weeks in a pan and 3 weeks in a rest cage. With 9 rearing pans and 8 emergence units a minimum of 5,000 fleas are produced each month, and during periods of maximum production this number is doubled or trebled.

The rearing pans, illustrated in figure 1, are constructed of heavy galvanized iron and are 13 1/2 inches in diameter and 8 inches deep. About 3 heaping tablespoonfuls of powdered beef blood is mixed

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thoroughly with 3 pints of dry sand that has been passed through a 16-mesh screen, and the mixture is spread evenly over the floor of the pan to form a layer $1/8$ to $1/4$ inch deep.

A white rat is placed in a cage $7\frac{1}{4}$ inches long by $3\frac{1}{4}$ inches high by $3\frac{1}{4}$ inches wide. The cage is made of 4- or 2-mesh galvanized-iron hardware cloth. One end of the cage is hinged on the bottom and flanged on the top and sides to form a door, which is held closed by wire hooks.

The cage containing the rat is placed in a metal tray, which is placed on the sand in the center of the pan. The tray is made of light-weight galvanized iron, and is 8 inches long by $3\frac{1}{2}$ inches wide by $1/2$ inch deep. The floor of the tray is lined with blotting paper, to catch the urine and let it evaporate without wetting the sand in the pan. The blotting paper is changed twice a week.

About 500 newly emerged adult fleas are released on the rat, and the pan is covered with bleached muslin held in place with an elastic band. The female fleas leave the rat to oviposit, and lay most of their eggs in the sand. A few are laid on the blotting paper, but the number lost when the paper is changed is negligible.

The pan is kept in an air-conditioned room at a temperature of 80°F . and a relative humidity of 80 percent. The rat is fed daily with a piece of apple and a few pieces of dry commercial dog food (dog checkers). After 21 days the rat is removed from the pan and placed in a large cage for a resting period of several weeks before being reinfested. The sand containing flea eggs, larvae, and pupae is also removed from the pan and sifted through 8- and 16-mesh screens. The larger screen takes out any large debris and the finer screen takes out the cocoons.

The remaining sand, containing eggs and larvae, is placed in a pupation pan. This is an enameled or porcelain pan, 11 inches in diameter and 4 inches deep, covered with bleached muslin. Once each week the sand is sifted through a 16-mesh screen to remove the cocoons. When no more cocoons are found, usually after 3 or 4 weeks, the sand is discarded.

The cocoons are kept in emergence units, illustrated in figure 2. Each unit consists of a funnel, basket, wire hooks, collar, cover, and collecting jar. The funnel is an inverted glass pickle jar from which the bottom has been cut. The jar should be at least $6\frac{1}{2}$ inches in diameter and 9 inches deep, and the mouth should be designed for closure with a screw cap $2\frac{3}{4}$ inches in diameter (the size of a quart fruit jar). The cocoons are placed in the basket, which is $4\frac{3}{4}$ inches in diameter by $1\frac{1}{2}$ inches deep and is made of 16-mesh screen wire reinforced by a ring of 4-mesh hardware cloth. It is suspended from the rim of the funnel by three wire hooks. The collar is made of two of the ring portions of fruit-jar caps, soldered together. The funnel

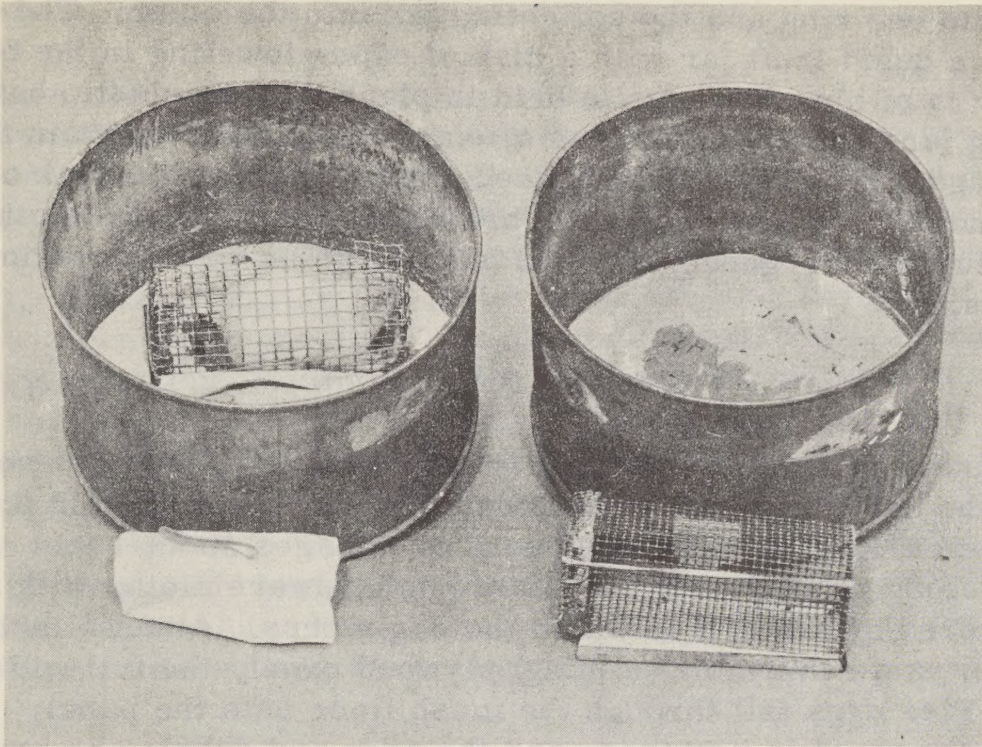


Figure 1.--Pans for rearing the oriental rat flea. The pan at the left is ready to be infested with fleas and closed with the cloth cover in the foreground.

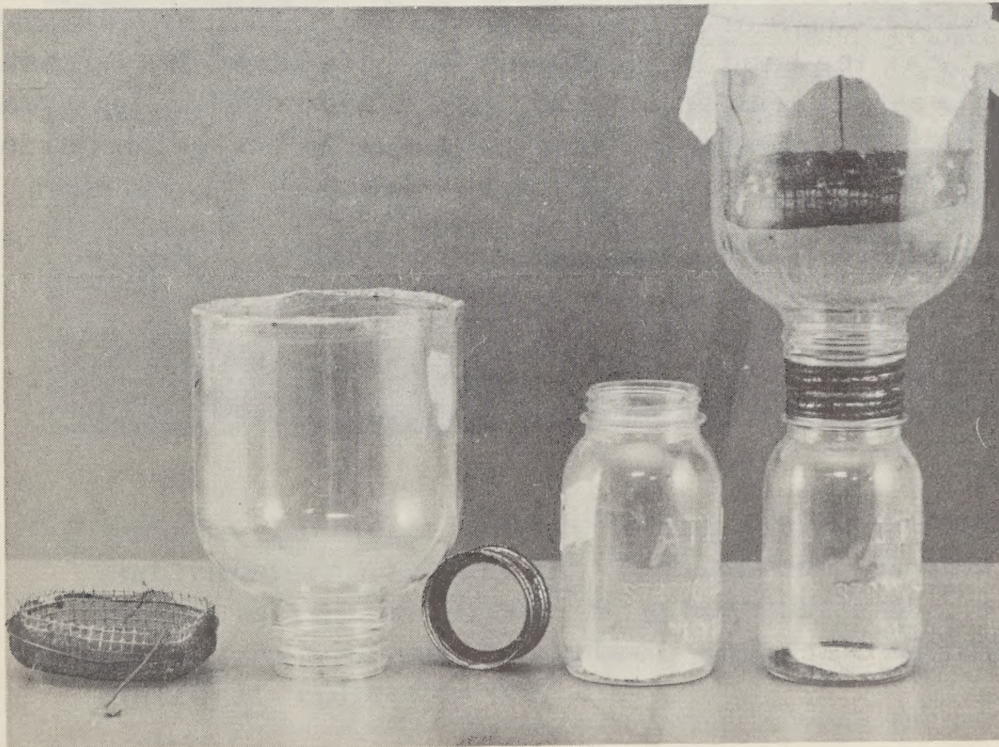


Figure 2.--Emergence units, in use and unassembled.

is screwed into one ring and the collecting jar into the other. The collecting jar is a quart fruit jar with a disk of paper toweling in the bottom, and the cover is of bleached muslin held in place with an elastic band.

Collecting jars can be changed as often as necessary to obtain fleas of a desired age. If a fresh jar is placed under a unit at the peak of emergence and the cocoons are gently breathed on through the cloth cover to stimulate emergence, several hundred fleas will be obtained in a few hours.

The Cat Flea

The method of rearing the cat flea is very simple. Dogs are confined during the day in a small yard infested with fleas. From 5 p.m. to 8 a.m. the flea-infested dogs are confined in cages about 4 feet square. The floor of each cage is of 2-mesh hardware cloth, with about one-third covered by a board on which the dog sleeps. About 1 inch below the floor is a removable (sliding) plywood panel, the full width of the cage. Flea eggs fall through the mesh floor onto the panel. Every 2 days the panel is removed, and the eggs and debris are brushed off into a dish and sifted through 16-mesh screen. The eggs and debris that pass this screen are placed in an enameled or porcelain pan, 11 inches in diameter and 4 inches deep, containing about 3 pints of dry sand mixed with 3 heaping tablespoonfuls of powdered beef blood. These rearing pans are kept at a temperature of about 80° F. and a relative humidity of about 80 percent. Under these conditions pupation begins after 10 to 13 days and emergence of adults after 13 to 15 days.

After the tenth day the sand in the dishes is sifted through 16-mesh screen twice a week to remove the cocoons. These cocoons are placed in emergence units and the newly emerged cat fleas are collected in the manner previously described for the rat fleas.

Handling Adult Fleas for Testing

Fleas can be removed from the collecting jar (fig. 3, E) in any desired number by fitting the jar with a glass funnel opening into a short piece of transparent, flexible plastic tubing, as illustrated in figures 3, 4, and 5. The glass funnel (fig. 3, B) should have a maximum outside diameter of 65 mm. It should be seated on a metal ring with attached rubber gasket (fig. 3, C), made by cutting the center from the disk portion of a standard metal two-piece fruit-jar lid. The ring and funnel make a flea-proof closure when fastened to the jar with the threaded metal collar (fig. 3, D) which is the collar portion of a standard glass two-piece fruit-jar lid. The threaded collar of a metal two-piece lid is too short to grip the threads of the jar securely when the funnel is in place.

Fleas are shaken through the funnel into the plastic tubing, and isolated between two clamps for counting, as shown in figure 5. When the desired number have been isolated, the distal clamp is removed and the fleas are released into the test chamber.

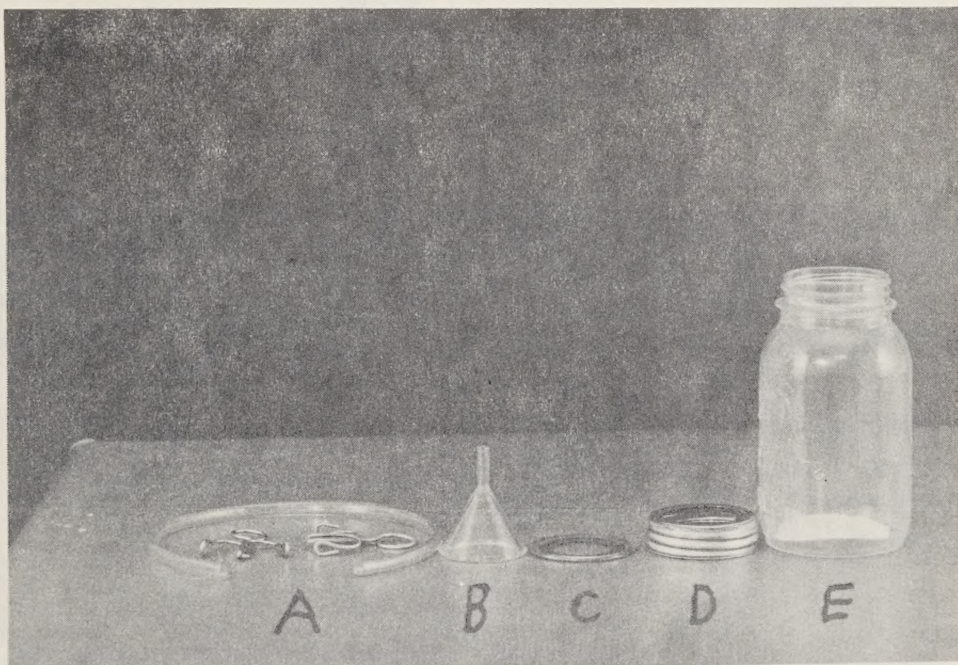


Figure 3.--Elements to fit collecting jar for counting and transferring fleas. A, Transparent, flexible plastic tubing and clamps; B, glass funnel; C, metal ring with attached rubber gasket; D, threaded collar; E, collecting jar.

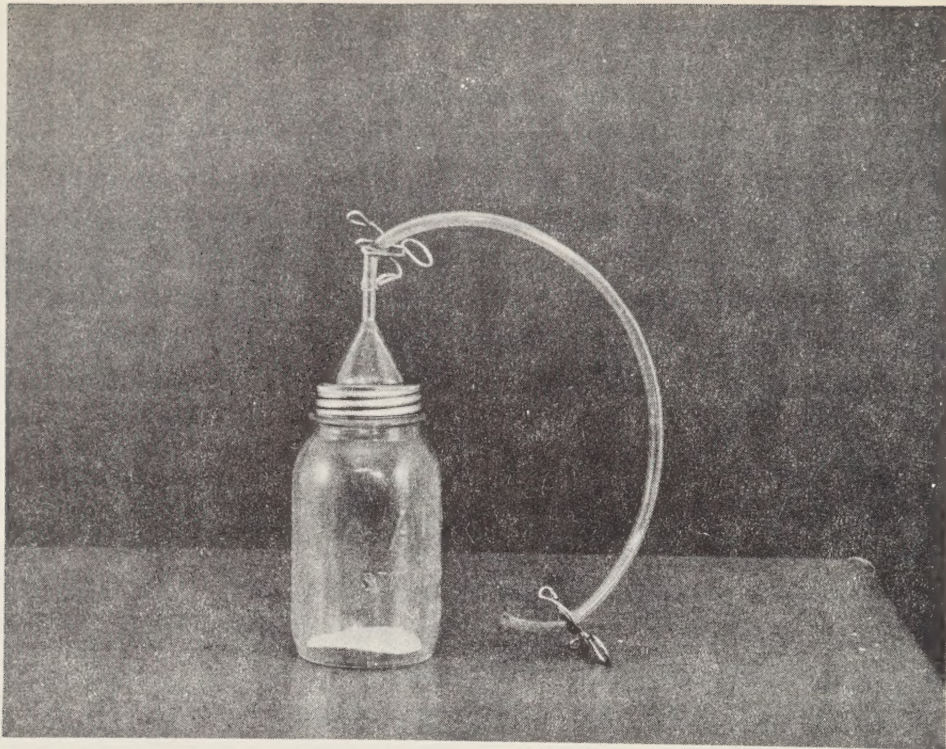


Figure 4.--Collecting jar fitted for counting and transferring fleas.

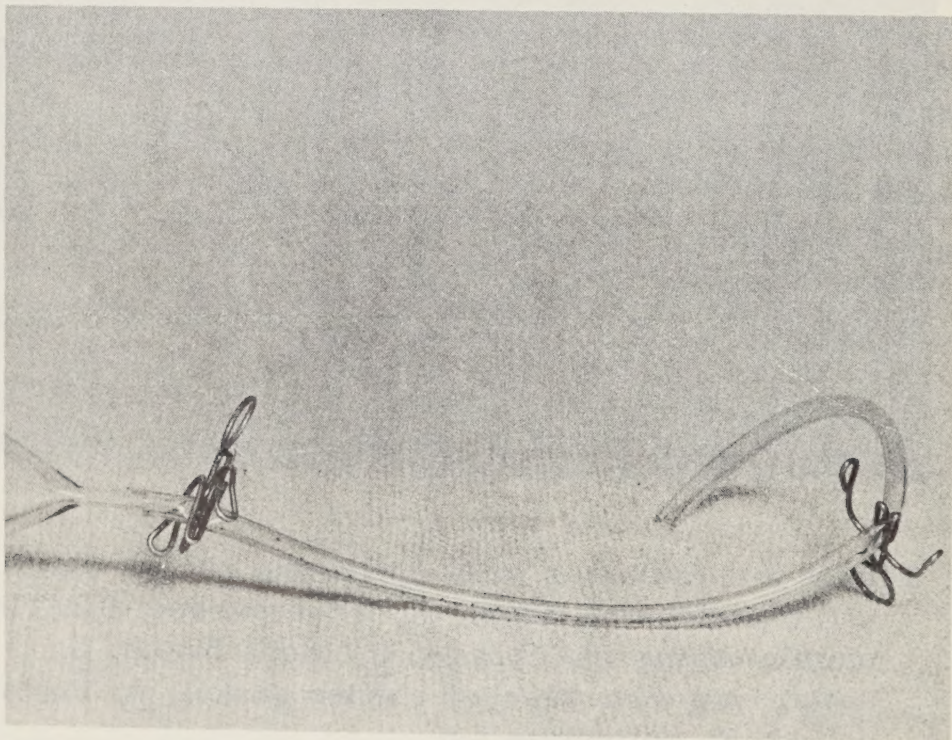


Figure 5.--Fleas isolated in transparent tube between two clamps for counting.